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Biological Report 82(11.105)
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TR EL-82-4

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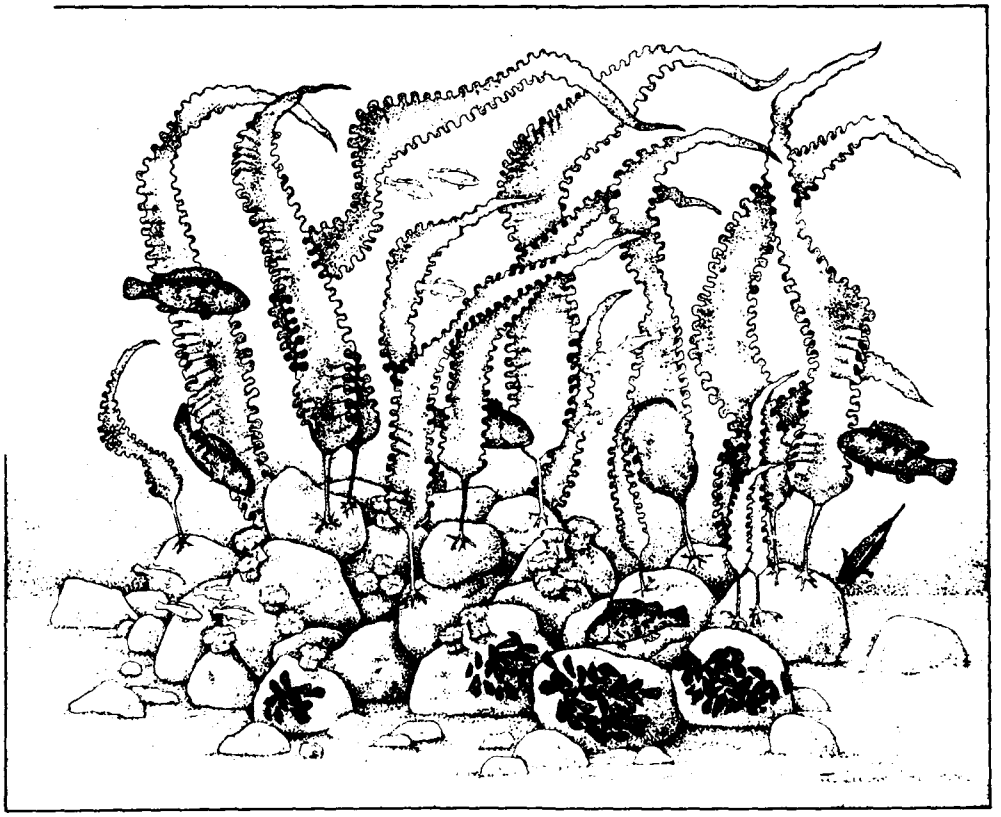
TAUTOG AND CUNNER



Fish and Wildlife Service
U.S. Department of the Interior

Coastal Ecology Group
Waterways Experiment Station
U.S. Army Corps of Engineers

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Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (North Atlantic and Mid-Atlantic)

TAUTOG AND CUNNER

by

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Vicksburg, MS 39180

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PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

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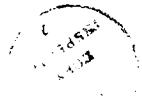

CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
meters (m)	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers (km)	0.5396	nautical miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35 31	cubic feet
cubic meters (m^3)	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons (t)	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (°C)	1.8(°C) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
square miles (mi^2)	2.590	square kilometers
acres	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
pounds (lb)	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (°F)	0.5556 (°F - 32)	Celsius degrees

CONTENTS

ACKNOWLEDGMENTS

I am grateful for the reviews by Alan Bejda of the National Marine Fisheries Service and Robert Sand of the University of Rhode Island. Their thoughtful comments greatly improved the text. Susan Stone prepared the illustrations and Jeanie Klemm expertly fed the computer the various drafts of the manuscript.

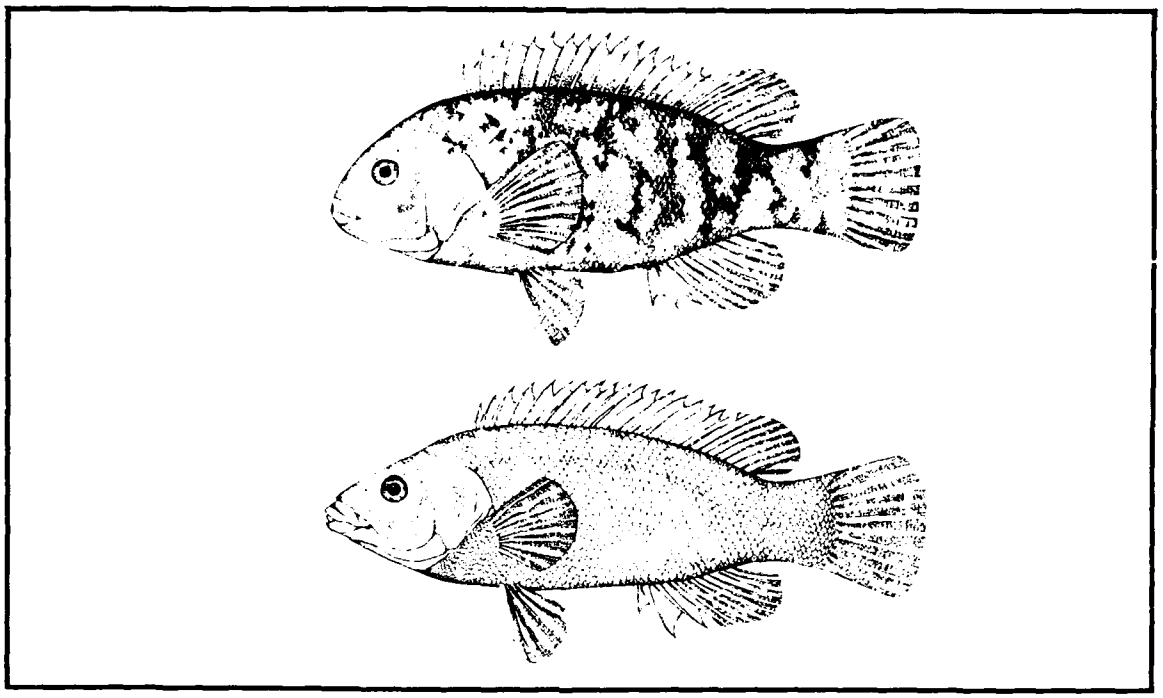

Figure 1. Tautog (top) and cunner (bottom).

TAUTOG AND CUNNER

NOMENCLATURE/TAXONOMY/RANGE

Scientific name.....Tautoga onitis
Preferred common name.....Tautog (Figure 1)
Other common names.....Blackfish, white chin
Class.....Osteichthyes
Order.....Perciformes
Family.....Labridae

Scientific name.....Tautogolabrus adspersus
Preferred common name.....Cunner (Figure 1)
Other common names.....Perch, sea perch, blue perch, bergall, chogset, choggy
Class.....Osteichthyes
Order.....Perciformes
Family.....Labridae

Geographic range: Tautog--coastal region of Nova Scotia to South Carolina; abundant from Cape Cod south to the Delaware Capes. Cunner --coastal region and offshore banks from Conception Bay, Newfoundland, and southwestern Gulf of St. Lawrence, south to New Jersey, and occasionally to the entrance of Chesapeake Bay (Bigelow and Schroeder 1953; Liem and Scott 1966) (Figure 2).

MORPHOLOGY/IDENTIFICATION AIDS

The tautog and cunner are the only two representatives of labridae along the northeast coast of the United States. They are easily distinguished from other co-occurring fishes in having a single long dorsal

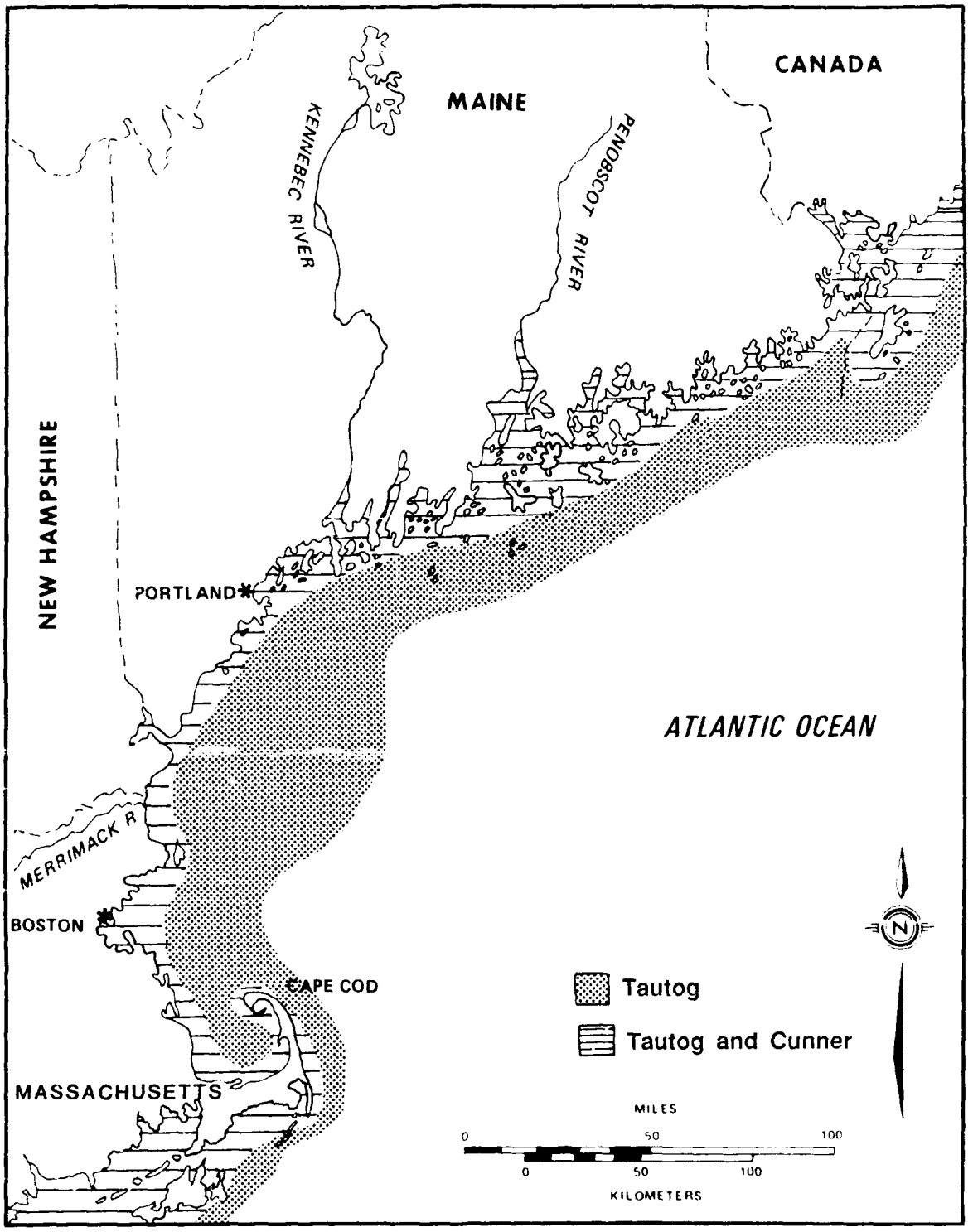

Figure 2a. Distribution of Tautog and Cunner in North Atlantic Region.

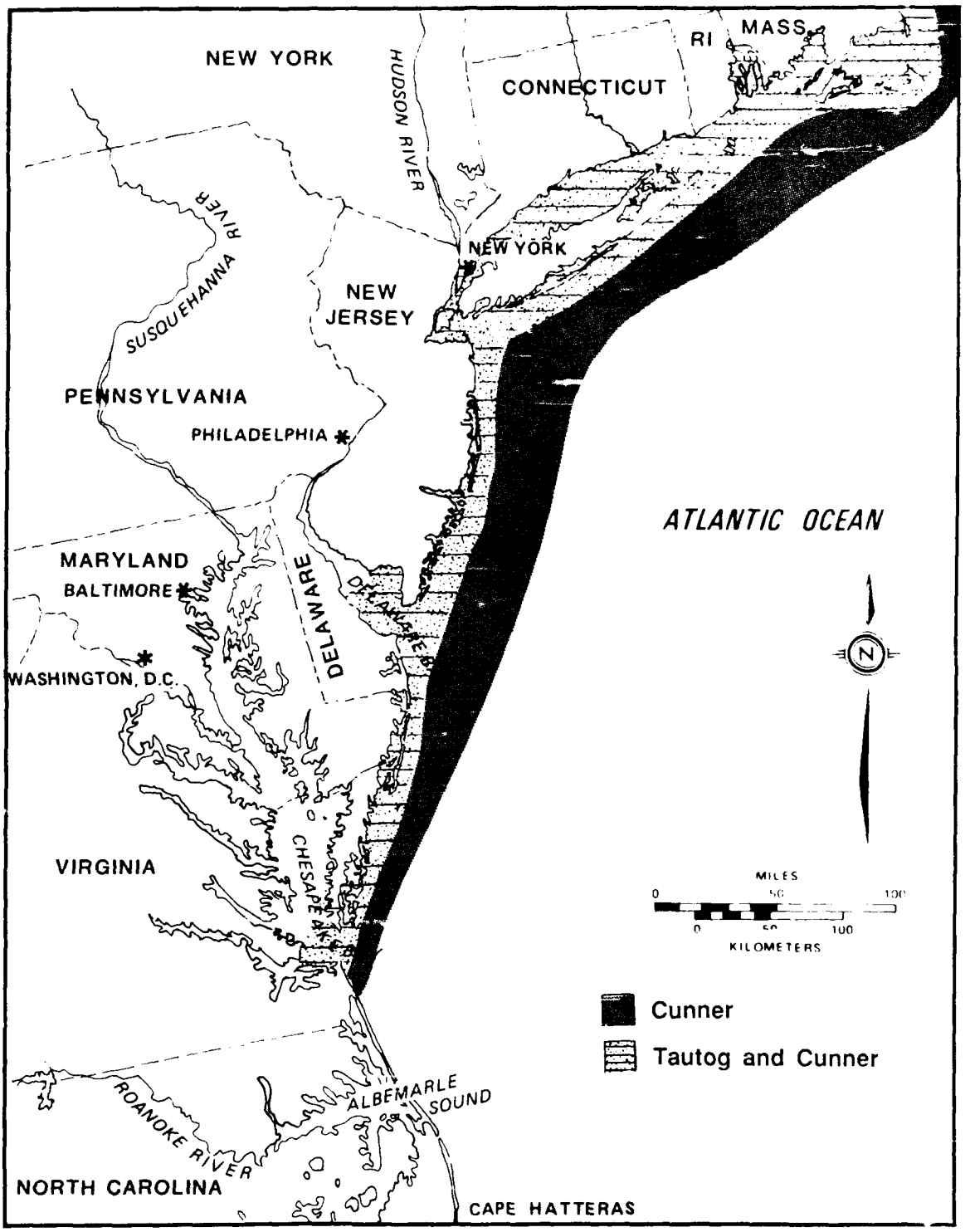

Figure 2b. Distribution of Tautog and Cunner in Mid-Atlantic Region.

fin, ventral fins almost directly beneath the pectorals, and a deep caudal peduncle. The anterior part of the dorsal fin is spiny; the rest is soft rayed. The point of division of spines and soft rays is not readily discernible. In both species, the roof of the mouth and the pharynx have crushing teeth suitable for breaking and grinding hard-shelled prey. The two species differ in dorsal profile from the mouth to the base of the dorsal fin; it is rounded in the tautog but relatively straight in the cunner. Also, the caudal peduncle is relatively wider and the caudal fin narrower in the tautog than in the cunner (Bigelow and Schroeder 1953; Liem and Scott 1966).

The adult tautog is blackish but has a slightly lighter ventral surface and a light to white chin. Juveniles have mottled or banded sides with black, gray, or green pigment. The color patterns of the cunner are variable; different areas are mottled brown, red, green, and blue. Young cunner (up to 10 cm total length) have a black spot at the anterior part of the soft dorsal fin rays (Bigelow and Schroeder 1953; Liem and Scott 1966).

The adult tautog is also much longer than the adult cunner. The tautog reaches a maximum length of 92 cm whereas the cunner has been recorded only up to 44 cm and generally does not exceed 31 cm (Bigelow and Schroeder 1953; Liem and Scott 1966).

Eggs, larvae, and postlarvae of tautog and cunner were described by Kuntz and Radcliffe (1918) and Williams (1967): These forms can be distinguished to species by morphological differences (Figures 3 and 4).

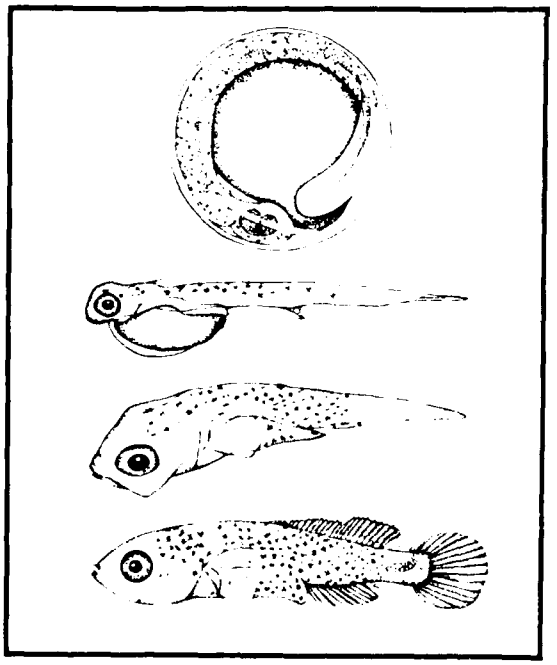

Figure 3. Tautog egg, 1-day-old 2.9 mm larva, 5 mm larva, and 10 mm fry (after Kuntz and Radcliffe 1918).

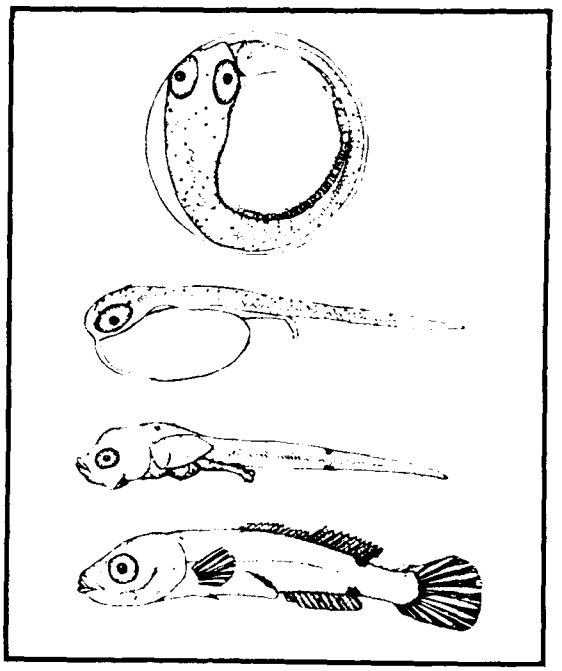

Figure 4. Cunner egg, newly hatched 2.2 mm larva, 4.2 mm larva, and 8 mm fry (after Kuntz and Radcliffe 1918).

REASON FOR INCLUSION IN SERIES

Both species are widespread along the northeast coast of the United States. (Bigelow and Schroeder 1953; Liem and Scott 1966). They are abundant in areas of rock reefs, piers, and other areas of high-relief habitat. Cunner are sometimes abundant enough locally in rocky pier habitats to exceed the biomass density of some tropical reef systems (Sand 1982). The tautog supports important coastal commercial and recreational fisheries. In as much as neither species migrates long distances, both may be key indicators of local stresses in the coastal regions along their range.

LIFE HISTORY

Spawning

In the tautog, the spawning season between Cape Sable, Nova Scotia, and Cape Hatteras, North Carolina, generally extends from mid-May to mid-August and peaks in June; in the cunner in the same region, it generally extends from early May to late August, and peaks in May-June (Colton et al. 1979). Cunner spawn in pairs or groups, depending on conditions (Wicklund 1970; Pottle and Green 1979; Pottle et al. 1981). **The male cunner in Conception Bay, Newfoundland, is territorial, with a territory of about 50 m^2. Possession of a territory is necessary for successful mating. Females may select males more on the basis of the males' own characteristics (frequency of aggression and courtship, and body size) than on the basis of qualities of the territories such as size. Male-male competition may affect male reproductive success (Martel and Green 1987). During the spawning season, territorial males shift the major period of feeding from afternoon to morning and most territorial behavior (courtship and aggression) occurs in the afternoon (Green et al. 1985). Large mature tautog have been observed spawning in pairs and in groups in the laboratory (Olla and Samet 1977; Olla et al. 1981). Younger sexually mature tautog (without the sexually dimorphic mandible) may spawn only in groups because small males are unable to compete aggressively with larger males for females (Olla and Samet 1977). Eggs of both species are buoyant and are generally confined to the coastal waters (Bigelow and Schroeder 1953; Richards 1959; Croker 1965).**

Fecundity and Eggs

Chenoweth (1963) showed that fecundity is size specific in the tautog. Fish 214-678 mm in fork length (weighing 170-5,207 g and 3-20 years old) contained 5,000 to 673,500 mature eggs. The model that describes the number of eggs (Y) related to length (X) in millimeters is

$$Y = -6.00307 + 3.0960X.$$

The relation of number of eggs (Y) to weight (X) in grams is

$$Y = 0.31492 + 1.07993X.$$

Tautog eggs have no oil globule, and are generally larger than cunner eggs (Kuntz and Radcliffe 1918). Egg size varies from year to year; reported diameters range from 0.70 to 1.14 mm diameter (Richards 1959; Chenoweth 1963). Year-to-year variation in reported measurements may be explained by time of sampling: mean diameters of eggs of both tautog and cunner generally decrease as spawning season progresses. This decrease is attributed to increasing water temperature (Williams 1967).

To the best of my knowledge, the fecundity of the cunner has not been investigated.

Tautog eggs hatch in 42-45 hours at 20-22 ^{o}C; probably 10-12 hours more

are required in colder water. Cunner eggs hatch within the same periods at similar temperatures (Bigelow and Schroeder 1953).

Larvae

Tautog larvae are about 2.2 mm long at hatching, and grow to about 3.3 mm in 96 hours at 20-22 °C. At this length, the yolk sac has been absorbed and the mouth is formed and functional. Dorsal and anal fins are distinct at 10 mm. At 30 mm, the fish show the general morphological characteristics of the adults. Most pigment cells are uniformly distributed over the trunk of the larval fish (Kuntz and Radcliffe 1918).

Newly hatched cunner are 2-2.2 mm long and have pigment cells distributed uniformly over the trunk. By 3 mm, the cells have migrated to form a pair of black spots on the dorsal and ventral sides between the base of the dorsal rays and the vent. The spots persist until the fish reach a length of to 20-25 mm; fish then develop the characteristic variable color pattern (Kuntz and Radcliffe 1918; Bigelow and Schroeder 1953). At 15 mm, the larval fish has the features of the adult.

Juveniles and Adults

Juveniles and adults of both cunner and tautog generally live together and depend on cover. Like all labridae, they are active during the day and become quiescent at night (Olla et al. 1975; Dew 1976). During this lethargic period, individual fish require shelter for protection. Habitat can include rock reefs, rock outcrops, gravel, eelgrass beds, and kelp. The functional requirement is that individual fish be able to remain alongside or under an object for shelter (Olla et al. 1974, 1975; Dew 1976). Shelter sites, therefore, may become a limiting factor of population size within a particular habitat, such as a rock reef (Olla et al. 1975), since all sizes of cunner and juvenile tautog (less than about 250 mm in total length) would require shelter of a similar size and type. Interspecific and intraspecific competition for shelter sites may occur. This hypothesis is supported because other reef fishes are limited by shelter; it is one of the factors that limit the size and diversity of coral reef fish assemblages (e.g. Smith and Tyler 1972).

Both species are active during the day, when they occur in loose aggregations near shelter sites. Current velocity can sometimes limit the area near shelter sites where the fish can forage (Auster 1987). Tautog are generally the less abundant species. Juvenile tautog, when of the same size as a portion of the cunner population, gain a protective advantage from predators by co-occurring with the numerically dominant species (Erlich and Erlich 1973; Frank and Leggett 1983; Auster 1984a).

Foraging in both species involves scan-and-pick feeding throughout the day (Olla et al. 1975; Dew 1976; Auster 1987). Cunner forage on a variety of benthic or near-bottom invertebrates (Bigelow and Schroeder 1953; Richards 1963; Chao 1973; Olla et al. 1975; Shumway and Stickney 1975; Sand 1982). Predominant prey species are blue mussels (Mytilus edulis), barnacles (Balanus spp.), soft shell clams (Mya arenaria), amphipods, shrimps, and small lobsters (Homarus americanus). Species and size of prey varies by habitat, latitude, and size class of fish.

Olla et al. (1975) showed that although juvenile tautog (in the size range of adult cunner) feed predominantly on mussels throughout the year, prey preferences of cunner

shift seasonally. Juveniles of both species preferentially prey on mussels during May and June. Adult tautog did so throughout the year (Olla et al. 1974). Cunner preferences shift primarily to isopods (Idotea baltica) from July to October.

Cunner and tautog move about to various degrees during the day. Daily movements of the cunner and juvenile tautog are generally within several meters to several hundred meters of their nocturnal shelter site (Green 1975; Olla et al. 1974, 1975, 1979). Adult tautog, however, commonly move away from their shelter site during the day to feed on mussels that may be several hundred meters away (Olla et al. 1974).

Cunner and juvenile tautog disperse to seasonal habitats during summer from perennial habitats that are occupied year-round by most of the population (Olla et al. 1979). Seasonal habitats may be eelgrass, beds of macro-algae, or mussels. The need to disperse may be driven by aggressive competition during spawning. Increases in aggression directed at some part of the population may reduce the optimality of the perennial habitat, causing individual fish to seek other areas (Olla et al. 1977, 1979). The return of the migratory group to perennial habitats in fall may also be due to the declining optimality of those habitats. Eelgrass and macro-algal stands are ephemeral habitats along most of the range of tautog and cunner. As the plants begin to die, the habitat value decreases. The migratory portion of the population shows no particular fidelity to perennial sites (Olla et al. 1979).

The fish overwinter at the perennial sites. They settle into individual shelters (crevices, along rock walls, under rocks), when temperatures reach between 8 and 5 ^{o}C, and remain "temperature debilitated" (torpid) until spring when water temperatures increase. Large fish become torpid before the smaller ones; thus, the smaller fish feed longer. Almost no feeding occurs during the period of torpor (Green and Farwell 1971; Olla et al. 1974, 1975, 1979; Dew 1976).

Seasonal movements, apparently driven by temperature, are greater in adult tautog. They occupy inshore habitats from April and May until late October. In winter, they generally move to deeper areas (25 to 45 m) with complex topography, where they may remain in torpor (Cooper 1966; Olla et al. 1974). In eastern Long Island Sound, overwintering adults have been seen in deep crevices of rocky reefs, inshore, at depths of less than 10 m (Auster, unpublished observation).

GROWTH CHARACTERISTICS

Cooper (1967) reported that in the tautog, males grow faster than females in length (i.e. 548 versus 501 mm average TL at age 22) but slower in weight (i.e., 1,716 versus 2,094 g average weight at age 20). The models describing the length-weight relationship are

$$\log W = -4.35670 + 2.77660 \log L \text{ (males)}$$

and

$$\log W = -4.80357 + 3.01607 \log L \text{ (females)}$$

where W = body weight (minus viscera) in grams and L = total length in millimeters.

Tautog are relatively slow growing for a heavily sought sport species. They require 9-10 years to reach a weight of 2 pounds (907 g), depending on sex. A 4-pound (1,814 g) fish is about 25 years old if male, or 15 years old if female. The greatest

recorded age of a tautog is 34 years (Cooper 1967).

Cunner grow considerably slower than tautog and reach a maximum age of 6 years (Cooper 1967; Serchuk and Cole 1974). Dew (1976) described the length-weight model for cunner as

$$\log W = -5.2512 + 3.2169 \log L$$

(both sexes). This model is similar to the one reported by Serchuk and Cole (1974) except that the authors did not use eviscerated weights. Neither reported differences in growth of cunner by sex.

FISHERY

Tautog populations north of Cape Cod have never been large, and have contributed little to the commercial or recreational catch (Bigelow and Schroeder 1953). South of Cape Cod, however, they are an important recreational species and support a small commercial fishery. They are primarily harvested with hook and line and by trawl, but some are caught with gill nets and by spearfishing (Blake and Smith 1984). The recreational catch (Table 1) is far greater than the commercial catch (Blake and Smith 1984; National Marine Fisheries Service 1980-1987; Sampson 1981). Tautog's slow growth and seasonal site tenacity may make it susceptible to overfishing. Some coastal states (Connecticut, Rhode Island, and Massachusetts) have recently established a minimum size limit of tautog for commercial or recreational fishermen. The regulations vary from state to state due to variations in fishing effort. No plan now exists for Federal management of the species.

The cunner was a favorite panfish during the late 19th and early 20th centuries (Bigelow and Schroeder 1953); however, landings were reported erratically. It is not now widely regarded as a commercial or sport species, but is a significant part of the catch of vacationing tourists and other bait fishermen along the shore (Serchuk and Frame 1973). No state regulates the landings of this species.

ECOLOGICAL ROLE

Cunner and tautog are year-round resident members of the nearshore fish assemblage and are locally abundant in their preferred habitats. Sand (1982) showed that the density of cunner was 3.9 fish/m^2 (80 g/m^2) in an area of Narragansett Bay, Rhode Island. These values for density and biomass are about 10 times larger than those for many temperate demersal fish assemblages and are within the range of tropical reef assemblages. Cunner and tautog both prey heavily on benthic organisms (Olla et al. 1974, 1975) and the effect of an individual tautog or cunner on benthic prey populations is equal to or greater than that of other individual predators such as gastropods or starfish (Sand 1982). Both species may be direct competitors with other benthic predators that prefer blue mussels as prey. These species include the commercially important American lobster (Weiss 1970).

ENVIRONMENTAL REQUIREMENTS

Temperature

Cunner become torpid when metabolism is depressed by falling water temperatures (Haugaard and Irving 1943). At about 8 °C, the largest fish remain in shelter throughout the day. As temperature decreases further, the smaller fish remain in shelters. As water temperatures increase in spring, the trend reverses, the smaller fish resuming activity before the large ones. Differences between the largest

Table 1. Estimated number (thousands) of tautog (top) and cunner (bottom) caught by marine recreational fishermen along the northeast and mid-Atlantic coasts of the U.S. (adapted from National Marine Fisheries Service, 1980-1987).

Year	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VI	TOTAL
1979	---	---	53	696	507	1,348	344	86	---	260	3,294
	---	66	681	532	780	1,360	322	---	---	---	3,741
1980	---	---	151	835	474	1,688	137	---	---	---	3,285
	---	---	595	1,025	1,035	1,197	525	---	---	---	4,377
1981	---	---	429	260	78	925	117	---	---	188	1,997
	---	---	714	149	365	783	252	---	---	---	2,263
1982	---	---	1,143	326	211	831	806	148	36	70	3,571
	30	---	625	631	241	914	828	---	---	---	3,269
1983	---	---	1,224	305	326	967	440	---	---	574	3,836
	---	48	737	479	---	1,800	2,149	---	---	---	5,213
1984	---	---	400	804	465	697	479	42	59	815	3,761
	---	---	342	835	534	1,903	1,113	---	---	---	4,727
1985	---	---	179	144	244	2,127	1,074	41	---	331	4,140
	---	---	418	929	323	1,340	165	---	---	---	3,175
1986	---	---	2,742	1,065	371	1,638	2,540	297	---	509	9,162
	---	---	108	517	690	1,272	110	---	---	---	2,697

and smallest fish are 1 to 3 weeks in both fall and spring (Dew 1976).

The behavior of juvenile tautog is identical with that of cunner during decreasing temperatures; the fish remain in torpor in shelters at perennial habitat sites throughout the winter (Olla et al. 1974). Adults migrate to deeper offshore sites when temperatures decrease to about 10 ^{o}C (Cooper 1966; Olla et al. 1974).

Responses of tautog when exposed to upper sublethal temperatures (26-32 ^{o}C) in the laboratory include shelter seeking during the day, and reduction in activity, aggressiveness, and feeding (Olla and Studholme 1975; and Olla et al. 1978, 1980). The fish remain closer to shelter while stressed, as they do at the lower sublethal temperatures. During periods when the fish are debilitated by temperature extremes, shelter seeking outside the diel cycle protects individuals from predators.

The shelter-seeking stress response in both species limits the ability of the fish to migrate when the local habitat is under stress.

Habitat

Both species require shelter sites at night, during which they rest or are torpid. Juvenile tautog and cunner of all sizes require adjacent shelter during the day as well (Olla

et al. 1974, 1975). Biogenic habitats such as stands of eelgrass or of macro-algae are present only seasonally and are occupied only in summer. The fish return to their perennial habitat when seasonal habitats degrade (Olla et al. 1979). Interspecific and intraspecific competition for shelter sites may limit populations of both species. Cunner and juvenile tautog less than about 250 mm long require similar shelter sites (Olla et al. 1975). Individuals of either species that can not compete for optional shelter are exposed to increased risk of predation.

Other Environmental Factors

Current velocity has been shown to affect the small-scale spatial distribution and to change foraging behavior patterns of fish of different sizes and species, including tautog and cunner (Auster 1984b, 1985, 1987). Cyclical changes in current velocity over topographically complex habitats, which are shelter sites for cunner and tautog, shifted the small-scale spatial distribution of fish by size. For example, increasing current velocity causes increasing minimum size of cunner foraging on surfaces exposed to the current. Fish of different sizes within a species are limited in their maneuverability at specific current velocities. Areas exposed to currents become prey refuges for fish of specific sizes as velocity increases. These areas again become available, and others restricted, as tidal current direction shifts. Changes in current speed and direction, resulting in concomitant small-scale shifts in distribution, continuously shift the prey available to predators. This phenomenon may provide a short-term isolating mechanism for different sizes of fish to reduce both interspecific and intraspecific competition in what may be a food-limited system.

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16. Abstract (Limit: 200 words)

Species profiles are summaries of literature on the taxonomy, morphology, range, life history, and environmental requirements of coastal finfishes and shellfishes. They are designed to assist in environmental impact assessment. Tautog (Tautoga onitis) and cunner (Tautogolabrus adspersus) are common coastally distributed species along the northeast U.S. Both species are active during the day and require shelter sites at night, when they are inactive. They also require overwintering shelter when torpid. Cunner are omnivorous, feeding on a variety of primarily benthic species; tautog feed primarily on mussels (Mytilus edulis). Tautog spawn from mid-May to mid-August and cunner from early May to late August. Longevity of cunner, the smaller of the two species, is 6 years and that of tautog, the larger species, is about 34 years. Due to their nocturnal and low-temperature inactivity, these species are unable to avoid short-term detrimental environmental disturbances. Since they undertake no long-distance migrations, they are key indicators of site-specific stress along the coast.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms
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Life history
Ecological role
Environmental requirements

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